



NOTE BY THE DIRECTOR-GENERAL

**RESPONSE TO THE REPORT OF THE THIRTY-EIGHTH SESSION OF
THE SCIENTIFIC ADVISORY BOARD**

1. This Note presents the Director-General's comments on the report of the Thirty-Eighth Session of the Scientific Advisory Board (SAB) (SAB-38/1, dated 31 May 2024) and its ongoing work.
2. The SAB continues to provide advice on advancements in science and technology relevant to the Chemical Weapons Convention (the Convention) and the work of the OPCW. At a time when these advances are emerging at an accelerated pace, the role of the SAB remains critical. The Board's findings and advice are made available to all OPCW Member States via its session reports and its comprehensive reports on developments in science and technology in support of each of the Review Conferences.¹ Its scientific endeavours are particularly important for those States with more limited resources, ensuring that every State Party has access to current, relevant developments in science and technology, thereby enabling effective governance of the Organisation.
3. The Director-General continues to draw upon the SAB's expertise, advice, and recommendations for the benefit of the Organisation. Rapid developments in science and technology are enhancing and enriching human existence. The integration of artificial intelligence (AI) into many of these developments is further increasing their impact. AI is a transformative technology with applications across various disciplines relevant to the Convention, including robotics, cloud laboratories, drones, and biotechnology. AI streamlines processes, optimises resource allocation, and drives innovation. In chemistry and related fields, it is accelerating progress by making processes cheaper, faster, and more effective. However, for all the benefits and opportunities that new technologies, such as AI, bring to the world, the potential for them to be misused must always be monitored and considered. It is in this context that the SAB continues its function—identifying both risks and opportunities that stem from science and technology—and generates a shared understanding of the areas that require attention by States Parties in their policymaking.

¹ Review Conference = Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention.



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4. The SAB met for its Thirty-Eighth Session from 27 to 31 May 2024 at the OPCW Main Building in The Hague, the Netherlands. The session was chaired by Mr Günter Povoden, with Prof Imee Su Martinez serving as Vice-Chairperson. The report of the session was issued as SAB-38/1.
5. After reviewing the report of the Thirty-Eighth Session of the SAB in depth, the Director-General submits the following comments to the Executive Council.

RECOMMENDATIONS TO THE DIRECTOR-GENERAL (CONTAINED IN EXECUTIVE SUMMARY OF SAB-38/1)

6. The Director-General acknowledges the recommendations made by the SAB in the report of its Thirty-Eighth Session and has carefully considered them.
7. The Director-General agrees with the recommendation of the SAB to establish a new temporary working group (TWG) focused on AI. The Director-General will work closely with the SAB Chairperson and others involved to determine the next steps in setting up this TWG.
8. The addition of four entries to Schedule 1.A of the Annex on Chemicals to the Convention (Annex on Chemicals) is a welcome update and demonstrates the commitment of States Parties to ensure that the Convention remains as effective as possible. However, the addition of these entries is just the beginning, and significantly more information on these chemicals is needed to assist the Technical Secretariat (the Secretariat) in its ongoing inspection and verification work. The Director-General attaches the utmost importance to safeguarding the health and safety of OPCW staff: data and information related to toxicities, medical countermeasures, and personal protective equipment (PPE) in particular, are therefore needed. He appreciates the Board's focus on this topic, and reiterates his interest in the SAB and the Secretariat pursuing a topical workshop or some other mechanism to facilitate increased information sharing in this important domain.
9. The Director-General recognises that one of the strengths of the SAB is its diversity, not just in background and geography, but also in experience and expertise. Given the breadth of the activities that the Secretariat is engaged in, drawing upon this expertise only adds to the effectiveness of training and other awareness-raising efforts. The Director-General acknowledges the commitment of SAB members to assist in OPCW-related events, where appropriate, and encourages Secretariat staff to continue to harness all resources at their disposal to maximise the utility and impact of OPCW activities.

ARTIFICIAL INTELLIGENCE-ASSISTED CHEMISTRY (PARAGRAPHS 18.1 TO 18.5, PARAGRAPHS 22.1 TO 22.7, AND PARAGRAPHS 23.1 TO 23.7 OF SAB-38/1)

10. The Secretariat, aided by the SAB and other external experts, is paying close attention to the development of AI across different domains. Large language models are maturing rapidly, and more bespoke uses, such as chemistry-specific models, are also developing at speed. It is prudent therefore that the Board always consider new and innovative uses of AI technology in its sessions.

11. The Director-General appreciates Prof Bartosz Grzybowski's work in fundamentally teaching computers the rules of chemistry, such that AI-based approaches are able to make meaningful contributions in chemistry, particularly in the field of synthetic design. The importance of quality data, both positive and negative, cannot be overstated. The methods and approaches being developed by the Grzybowski research group will be instrumental in allowing laboratory-based synthesis to be brought up to production scale for use in commercial applications. This is the ultimate goal when designing and synthesising new chemicals, whether for medicinal or other purposes. It is also noteworthy that the Grzybowski research group already recognises the potential for its methods to be misused and is taking precautions against this.
12. Prof Tim Noël's research group is conducting useful research in optimising photocatalysis reactions using flow chemistry and self-driving laboratories. The Director-General notes with interest the research group's innovative approach to utilising autonomous software to cycle through different reaction parameters, enabling reaction conditions to be optimised quickly, and almost always leading to yields in excess of published values. Additionally, using flow chemistry techniques allows for toxic or hazardous substances to be created in small, safe amounts in situ, reducing any safety risks associated with the reaction process. The Director-General notes that AI processes are being increasingly integrated into chemical production processes, resulting in more automated optimisation and synthesis of increasingly complex chemical compounds. That being said, these approaches tend to still be at the research stage, and require chemistry expertise and experience. This is certainly an area of research that requires continued monitoring, given its potential.
13. Prof David Wishart is using chemical language models to develop useful approaches to predicting structures and properties of chemical compounds, and is utilising developed libraries to help law enforcement identify novel psychoactive substances. There is great potential in generating very useful predictive information about chemical compounds using chemical language models, as evidenced by Prof Wishart's work. The Director-General highlights the potential for similar approaches to be used to provide realistic data and information associated with the four newest entries to Schedule 1.A of the Annex on Chemicals, as well as other toxic chemicals where available data is sparse.

AGRICULTURAL DRONES (PARAGRAPHS 19.1 TO 19.5 OF SAB-38/1)

14. While the acquisition, whether by purchase, theft, or synthesis, of toxic chemicals is a necessary step in any weaponisation efforts, the means of delivery and/or dissemination is of equal importance. The Director-General views the monitoring of advances in technologies that can be used to deliver chemical weapons and/or disseminate toxic chemicals as critical. Of particular concern are unmanned aerial vehicles (UAVs)—commonly known as drones—used in agricultural applications. These drones are specifically developed to deliver large quantities of toxic chemicals, such as pesticides, efficiently and over wide areas. The potential for their misuse is an ongoing concern.
15. The Director-General appreciates that the SAB invited Prof Steve Li to brief them on his research on agricultural drones and some of the latest advances in the field. The use of drones to spray fertilisers or pesticides can be highly beneficial in a number of scenarios. In fact, smaller quantities of chemicals can often be used given the targeted and efficient nature of drone spraying, reducing adverse effects in the environment. The

Director-General recognises the advances in this field but the potential for misuse must also be monitored concurrently, providing a clear understanding of the state of the art, the availability of the technology, and the regulations and restrictions that exist.

16. The Director-General requests that the SAB continue to focus on the area of delivery and dissemination, as the opportunities for misuse of consumer and industrial technologies may increase with continued innovation and wider availability.

NEW TECHNOLOGIES, APPROACHES, AND INNOVATIONS RELATED TO MISSION PREPAREDNESS (PARAGRAPHS 13.1 TO 13.7, PARAGRAPHS 14.1 TO 14.5, AND PARAGRAPHS 20.1 TO 20.8 OF SAB-38/1)

17. Identifying advances in technologies that support the operational elements of the Organisation's work is paramount to assuring a fit-for-purpose Organisation.
18. Dr Gerald Bauer and his team in the Austrian armed forces are conducting useful and practical research to better understand new and emerging threats, as well as how best to detect and counter them. Their collaborative approach allows them to be effective and efficient with limited resources. Of particular note is their work on detecting and identifying Schedule 1 nerve agents in the field, as well as their efforts to better understand how different sensor systems can be mounted and used on UAVs.
19. Likewise, understanding fate and degradation of nerve agents is crucial to knowing whether, and the extent to which, decontamination and remediation efforts are successful, should they be needed. The work being undertaken by Ms Helen Mearns and her team to explicitly detail the decontamination-generated degradation products of persistent nerve agents will be beneficial to all first responders, as well as those who need to deal with these toxic compounds.
20. Advances to PPE that can increase the safety of OPCW personnel on missions are always welcome. The Director-General therefore read with interest the research by Prof Omar Farha and his team in their efforts to incorporate metal-organic framework technology into protective suits and masks with a view to increasing their efficacy. These specially tuned nanomaterials potentially offer a considerable advantage over traditional activated carbon in that they can not only adsorb toxic chemicals, but also catalytically detoxify them. It is interesting to note that their commercialisation is now under way. The Director-General requests the SAB to continue to monitor advances in PPE relating to innovative materials, as these offer the potential to drastically improve the options available to OPCW staff in hazardous situations.

WORK OF THE OPCW INSPECTORATE DIVISION (PARAGRAPHS 12.1 TO 12.5 AND PARAGRAPHS 15.1 TO 15.4 OF SAB-38/1)

21. With the destruction of all declared chemical weapons stockpiles having been completed, the OPCW has increased its focus on preventing the re-emergence of chemical weapons. This necessitates a change in approach and organisation in order to meet new challenges and expectations. The Inspectorate, in particular, is adapting so as to be able to meet new mission-related needs. Simultaneously, with the commissioning of the Centre for Chemistry and Technology (the ChemTech Centre), there are additional assets available to ensure inspector preparedness and operational readiness to meet a host of different potential mission needs and situations.

22. The additional space and functionality of the ChemTech Centre allows, among other things, for the Secretariat, led by Inspectorate personnel, to integrate an equipment test bed into its operations.
23. The Director-General acknowledges the importance of this new test-bed capability and how it will further optimise Secretariat inspection and verification work. He encourages the Secretariat to make use of the SAB members' expertise to strengthen its approach to establishing this test bed, both by participation in a focused requirements workshop as well as through ongoing consultation.

NAVIGATING THE VX NERVE AGENT INCIDENT AT KUALA LUMPUR INTERNATIONAL AIRPORT 2 IN MALAYSIA (PARAGRAPHS 21.1 TO 21.3 OF SAB-38/1)

24. When chemical weapons attacks occur, it behoves the Organisation, wherever possible, to learn from what transpired, both from the act itself and the response, which may include technical, operational, legal, and other components. The Director-General appreciates the presentation by Dr Raja Subramaniam and his recounting of the extraordinary efforts that the Malaysian authorities undertook to hold the perpetrators of the 2017 VX attack in the Kuala Lumpur airport accountable. There are valuable lessons learned from the investigation that are crucial to retain and use to further strengthen investigatory efforts in any future alleged use of a chemical weapon.

UPDATES FROM THE OPCW TECHNICAL SECRETARIAT (PARAGRAPHS 6.1 TO 6.3, PARAGRAPHS 8.1 TO 8.4, PARAGRAPHS 9.1 TO 9.4, PARAGRAPHS 10.1 TO 10.5, PARAGRAPHS 11.1 TO 11.4, AND PARAGRAPHS 16.1 TO 16.7 OF SAB-38/1)

25. The shifting focus from destruction to preventing the re-emergence of chemical weapons necessitates a shift in OPCW activities. Periodic updates from Secretariat staff on programmes and activities that have scientific components, such as the work of the OPCW Laboratory, the International Cooperation and Assistance Division, and the Open-Ended Working Group on Terrorism, provide the SAB with a firm basis of understanding of the different workstreams within the Organisation. This allows the SAB to better provide meaningful advice related to the scientific and technological elements. The Director-General recognises the utility in ensuring that the Board understands the work of the Organisation and supports the continuation of this approach.

CHEMICAL FORENSICS (PARAGRAPHS 7.1 TO 7.5 AND PARAGRAPHS 17.1 TO 17.4 OF SAB-38/1)

26. The threat spectrum is expanding, with growing numbers of malicious actors having increasing opportunities to weaponise an expanding list of toxic chemicals. This presents an ongoing challenge to the investigative capability of the Organisation, and the need to be prepared for so many different scenarios is resource intensive. However, the focus should continue to be on the Organisation's ability to investigate the misuse of chemicals as weapons. Therefore, any information that a chemical sample may hold is potentially important to any investigation into that misuse. While the identification of the toxic chemical is paramount, the tangential pieces of information that may be present in samples, such as impurities or similarity to other samples, are of additional significance. This information could help determine whether a particular synthetic route

was used in production, whether a chemical agent or precursor was produced in a specific geographic location or region, or what environment the chemical has been subjected to, such as extreme temperature or humidity.

27. The Director-General established the TWG on Chemical Forensics in late 2023 to help identify existing and new methods to ensure that all available information is extracted from a given chemical sample. In addition, the TWG will help the Organisation better understand the logistical and operational aspects of using chemical forensics techniques, and ultimately how the OPCW can strengthen its chemical forensics capabilities. The Director-General appreciates the update provided by Dr Anne Bossée, the Chairperson of the TWG, and looks forward to future updates from the Group.
28. Use of chemical weapons agents often leaves behind a trace—an indication that they were once present. These traces may be in the form of the intact agent or degradation products, specific reacted species, or adducts to chemicals in the body. The work of Dr Crister Åstot and his team in elucidating markers specific to the exposure of chlorine gas is promising. Innovative approaches to this challenge are needed, and the Director-General appreciates the SAB's continued monitoring of developments in this field.

SAB DISCUSSIONS AND UPDATES (PARAGRAPHS 24.1 TO 24.3, PARAGRAPHS 25.1 AND 25.2, AND PARAGRAPHS 26.1 TO 26.6 OF SAB-38/1)

29. Sharing experiences and knowledge gained from conferences and other scientific fora makes a fundamental contribution to the success of the SAB. Board members add to the collective knowledge of the SAB, which in turn assists in its effective monitoring of scientific and technological advances.
30. It is both fitting and noteworthy that the SAB has already begun thinking about its scientific report for the Sixth Review Conference. The SAB's scientific report is always an extensive compilation of advances in science and technology, and ensures that all States Parties have a comprehensive dossier of the current science and technology that matter to the Organisation and the implementation of the Convention. The Director-General commends the members of the Board for their advance preparations on this report.

CLOSING REMARKS

31. The Director-General acknowledges the SAB Chairperson and Vice-Chairperson for their able guidance of the Board. He notes the election of Prof Imee Su Martinez as Chairperson of the Board, and the election of Prof Elisa Souza Orth as Vice-Chairperson for 2025. He thanks Mr Günter Povoden for his strong leadership as Chairperson over the last three years. The Director-General also thanks the four members of the Board who are completing their tenure at the end of 2024, namely, Mr Günter Povoden of Austria, Prof Andrea Leisewitz of Chile, Prof Mostafa Ghanei of the Islamic Republic of Iran, and Mr Wilford Jwalshik of Nigeria. Their contributions while on the Board have ensured that the SAB continues to produce high-quality scientific advice that positively impacts the work of this Organisation.
32. Lastly, the Director-General expresses his thanks to all States Parties, organisations, and institutions that have financially assisted the work of the SAB.